Hochschule Karlsruhe
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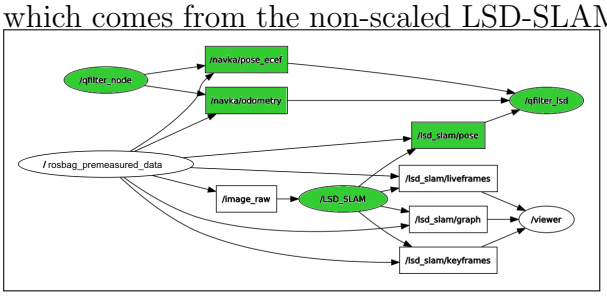
ALGORITHMS, SYSTEMS AND SOFTWARE DEVELOPMENT FOR AN IMAGE AND GNSS/MEMS-BASED NAVIGATION AND OBJECT-REFERENCING

The employment of visual sensor in GNSS/MEMs other sensors is investigated in this thesis. The approach utilises the QFilter estimated navigation vector from GNSS/MEMs and therefore integrates monocular SLAM navigation vector. The investigation uses the semi-dense monocular large scale direct SLAM "LSD-SLAM" estimated position and orientation to be loosely coupled with QFilter. Thus the estimated state vector can be read in: $\mathbf{y} = \left[\mathbf{x}\,\mathbf{y}\,\mathbf{z}\,|\,\dot{\mathbf{x}}\,\dot{\mathbf{y}}\,\dot{\mathbf{z}}\,|\,\ddot{\mathbf{x}}\,\ddot{\mathbf{y}}\,\ddot{\mathbf{z}}\,||\,\boldsymbol{\omega}_x\,\boldsymbol{\omega}_y\,\boldsymbol{\omega}_z\right]^T$ The resulting trajectory from scale and discontinuity which comes from the non-scaled LSD-SLAM.



loosely coupling sensor integration.

Overcoming the drifting in scale and trajectory discontinuity, LSD-SLAM navigation vector has to be tightly coupled in QFilter. Thus, IMU can be used estimating visual sale factor.

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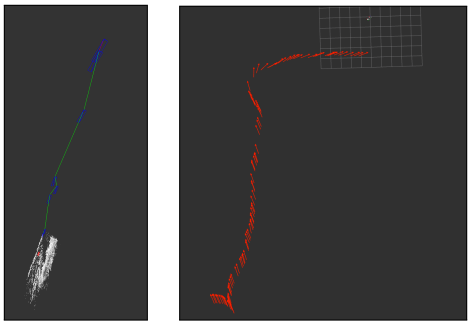


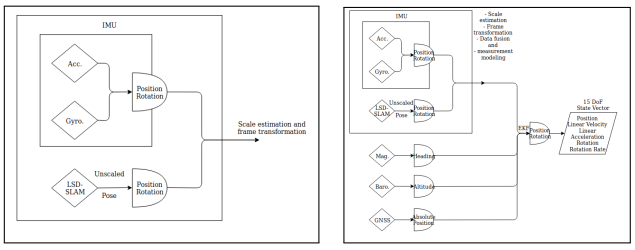
Left: LSD-SALM odometry. Right:LSD-SLAM QFilter integration odometry.

Conclusion

To conclude, the sensor integration result is not sufficiently estimating the state vector since the visual algorithm LSD-SLAM provides a non-scaled navigation vector. The better thinking of a sustainable solution is to consider both scaling LSD-SAM likewise sensors influences via tightly coupling technique. Therefore, the estimation of the visual scale factor and the final state vector can be like in the following equations:

$$\mathbf{x}(t)^{e}_{S_i} = \mathbf{R}^{e}_{m}\,\mathbf{R}^{m}_{b}\,\mathbf{R}^{b}_{p}\,\mathbf{R}^{p}_{S_j}\,s\,\mathbf{R}^{S_j}_{S_i}\,\mathbf{x}(t)^{S_i}_{LSD-SLAM}$$

$$\mathbf{y} = \left[\mathbf{x}\,\mathbf{y}\,\mathbf{z}\,|\,\dot{\mathbf{x}}\,\dot{\mathbf{y}}\,\dot{\mathbf{z}}\,|\,\ddot{\mathbf{x}}\,\ddot{\mathbf{y}}\,\ddot{\mathbf{z}}\,||\,\boldsymbol{\omega}_x\,\boldsymbol{\omega}_y\,\boldsymbol{\omega}_z\,|\,\mathbf{s}\right]^T$$



scale estimation via tightly coupling.